SIN 346

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Suppliers' Information Note

For The BT Network

BT ADSL
INTERFACE DESCRIPTION

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1. Introduction & scope

This supplier information note (SIN) describes the interface presented at the end of an ADSL line at the end customer premises. It is one of a family of SINs relating to ADSL delivered services. As such it is a generic SIN relating to all BT ADSL delivered services where the end user modem is not part of the BT network. Other service related SINs (eg SIN 482 BT IPstream Connect) will describe the protocol stacks needed on top of ATM to terminate the particular service.

ADSL technology requires the use of analogue filters to separate PSTN and ADSL signals carried on the same line. This document describes three possible connection topologies for the filters:

- using multiple self-installed CPE ADSL filters, typically one for each item of PSTN CPE.
- using a single self-installed CPE ADSL filter deployed between the Linebox and all PSTN CPE.
- using a BT supplied ADSL Linebox adapter.

In the self-installed CPE filter configurations (**Figure 1**) the NTP for both the BT-provided ADSL service and the BT-provided PSTN service is at the BT-provided Line Box and PSTN adapter.

In the BT-supplied ADSL Linebox adapter configuration (**Figure 2**) the NTP for the BT-provided ADSL service appears at one socket of the adapter and the NTP for the BT-provided PSTN service appears at the other socket of the adapter.

This SIN describes recommendations for the ADSL modem equipment required to terminate a BT ADSL line. It also describes recommendations for CPE ADSL filter devices.

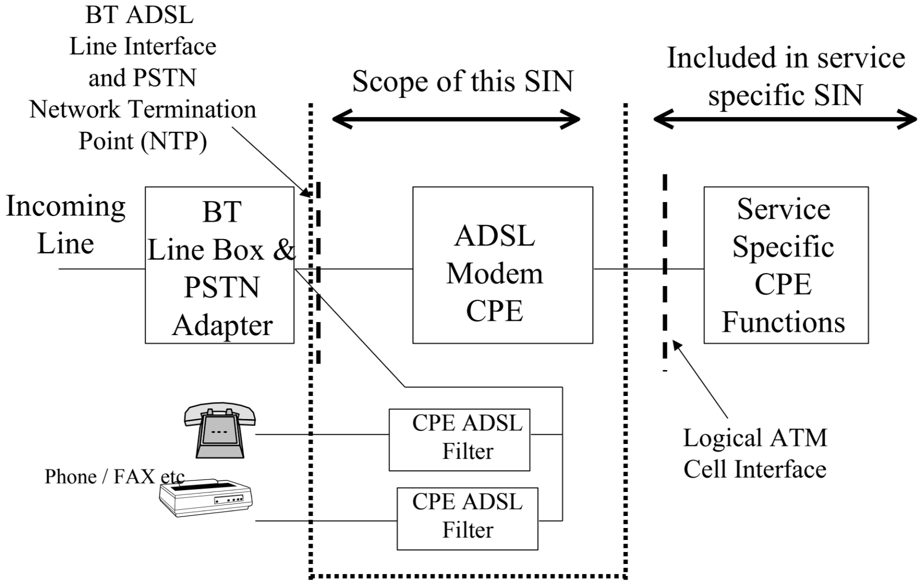
BT ADSL
Line Interface
and PSTN
Network Termination
Point (NTP)
Scope of this SIN
Included in service
specific SIN
Incoming
Line
BT
Line Box &
PSTN
Adapter
ADSL
Modem
CPE
Service
Specific
CPE
Functions
CPE ADSL
Filter
CPE ADSL
Filter
Phone / FAX etc
Logical ATM
Cell Interface

Figure 1. Scope of this ADSL Suppliers' Information Note (CPE ADSL Filters)

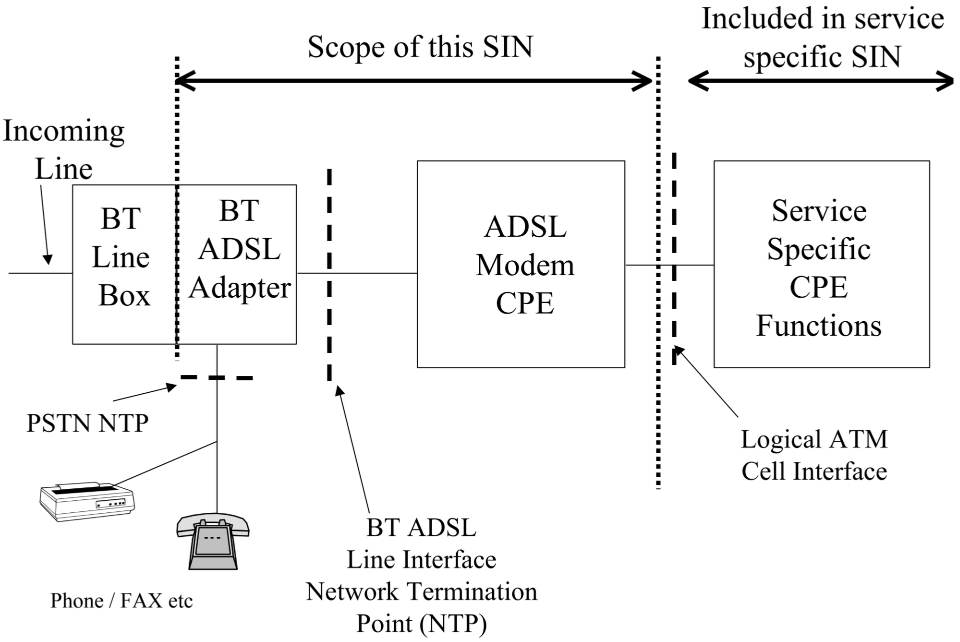
Included in service specific SIN
Scope of this SIN
Incoming Line
BT Line Box
BT ADSL Adapter
ADSL Modem CPE
Service Specific CPE Functions
PSTN NTP
Logical ATM Cell Interface
Phone / FAX etc
BT ADSL Line Interface Network Termination Point (NTP)

Figure 2. Scope of this ADSL Suppliers' Information Note (BT ADSL Linebox adapter)

2. Incompatible PSTN services

Some existing PSTN based services may be affected by the techniques used to deliver ADSL services over the same metallic line, and hence are not supported on ADSL lines.

Compatibility statement

BT ADSL is not compatible with these BT services:

- 30k loop
- Private circuits
- ISDN – all types
- Home Highway or Business Highway
- Redcare ISDN
- Featurenet 5000 services
- Meterpulse facility
- PBX lines or Auxiliary lines
- Caller Redirect

BT intends to maintain compatibility between ADSL and Redcare services, both standard Redcare and Redcare GSM. However it is recognised that different installation procedures are sometimes required for Redcare. Further information on installation can be obtained from the Partners Resources section of the Redcare website at www.redcare.bt.com

End Users can only receive a single ADSL (Broadband) Service over a PSTN line.

Please note that this list is not exhaustive. BT will endeavour to update this list as new information becomes available.

3. CPE ADSL filters

3.1 Installation topology

In this case the filters are classed as Customer Premises Equipment (CPE) and could be deployed in two distinct topologies. Either multiple jack-connected CPE filters can be used as in the arrangement shown in **Figure 3**, or a single in-line filter can be provided as in the arrangement show in **Figure 4**. In all cases, there must be a filter function between the Linebox and *any* item of PSTN CPE, including PSTN modems, fax machines, etc.

When CPE ADSL filters are used the NTP for ADSL services to which this SIN relates is located at the Linebox (**Figure 1**), however the physical ADSL modem may be connected into one of the ADSL CPE filters as shown in **Figure 3**, or into Linebox as shown in **Figure 4**.

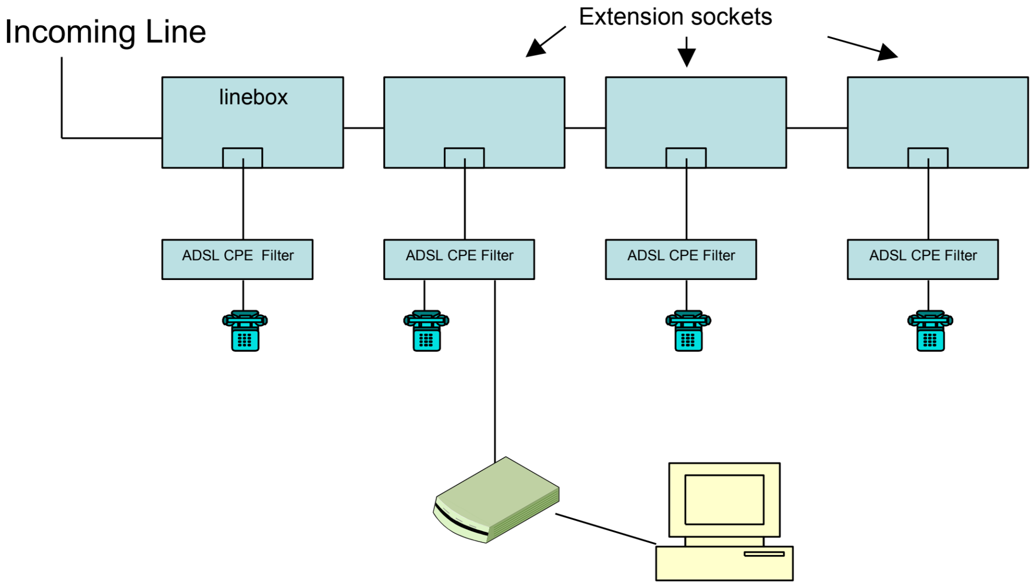
Incoming Line
Extension sockets
linebox
ADSL CPE Filter
ADSL CPE Filter
ADSL CPE Filter
ADSL CPE Filter

Figure 3. Customer end ADSL modem installation topology (multiple CPE ADSL filters)

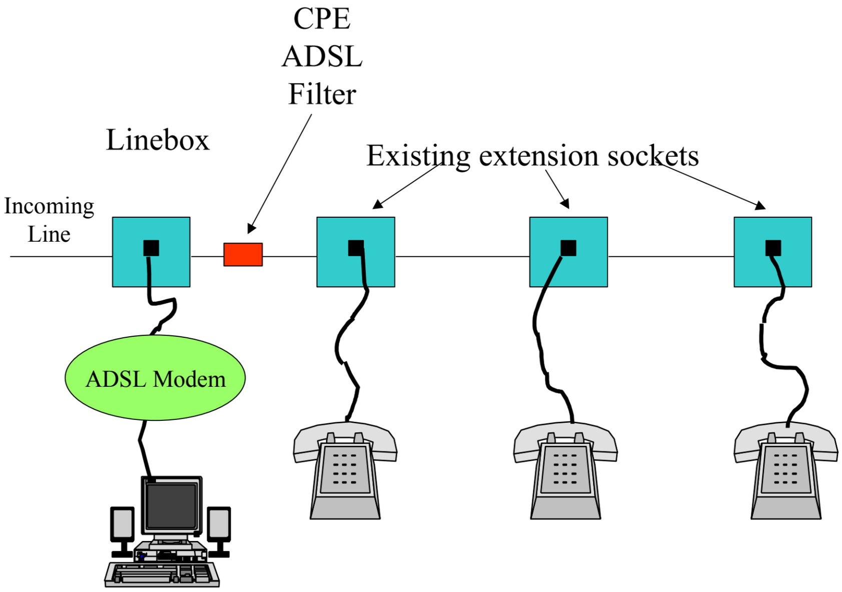

Figure 4. Customer end ADSL modem installation topology (single CPE ADSL filter)

Note that when an in-line CPE ADSL filter is in use as in **Figure 4** the ADSL modem can ONLY be connected at the Linebox, as the filter prevents the ADSL signal reaching the extension sockets.

3.2 Physical interface

When CPE filters are in use the NTP physical interface is the standard telephone socket on the Linebox as described in SIN 351[5]. Connections are given in SIN 351 and are reproduced in **Table 1** for information. The pin numbering convention is from the left looking into the socket with the contacts uppermost. The ADSL connection is to the 'A' and 'B' wires on pins 2 and 5. Polarity is unimportant.

1	Not Used for PSTN
2	'A' wire or 'B' wire
3	Local earth when required
4	Shunt connection, when required
5	'B' wire or 'A' wire
6	Not Used for PSTN

Table 1. BT telephone socket connections

The ADSL modem will generally connect into an ADSL CPE filter however, and this will provide conversion to a dual standard RJ11 / RJ45 jack as found on the BT supplied ADSL Linebox adapter described in the next section.

4. BT supplied ADSL Linebox adapter

4.1 Installation topology

When the service is terminated at the BT supplied ADSL Linebox adapter (illustrated in **Figure 6**) the ADSL service will be presented at a socket on the service adapter. The

ADSL Linebox adapter incorporates an electrical filter to separate ADSL and PSTN signals. It presents two sockets to the user, one for connection of an ADSL modem, the other for connection of a telephone. It also provides the facility for connection of telephone extensions.

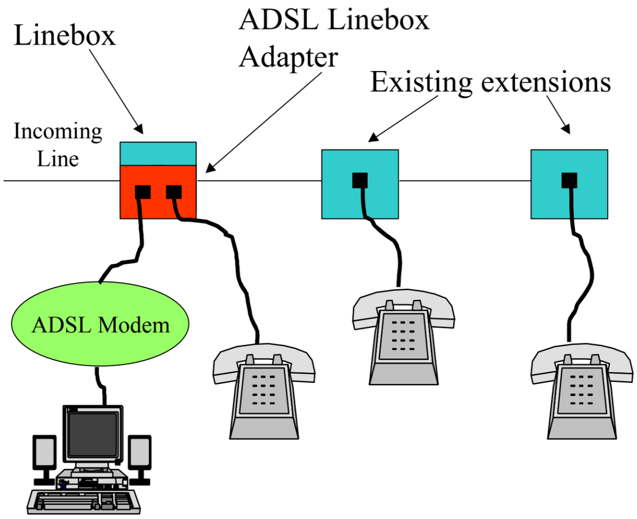

Figure 5. Customer end ADSL modem installation topology (Using BT ADSL Linebox Adapter)

Note that when an ADSL Linebox adapter is in use as shown in **Figure 5** the ADSL modem can ONLY be connected at the Linebox adapter, as the adapter prevents the ADSL signal reaching the extension sockets.

4.2 Physical interface

The standard line box and ADSL Linebox adapter for BT ADSL services are shown in **Figure 6**.

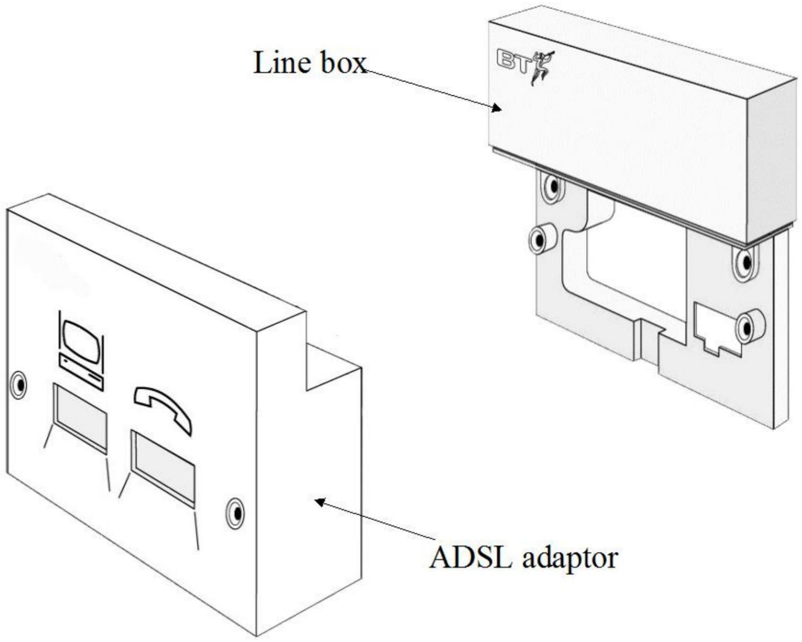

Figure 6. Standard line box and ADSL Linebox adapter

The ADSL Linebox adapter plugs into the Linebox in place of the standard PSTN adapter. It presents two sockets, one for connection of an ADSL modem and one standard telephone socket. Connectors for telephone extension wiring are also incorporated. The ADSL socket is on the left-hand side, and the phone socket is on the right.

The ADSL socket is a dual standard RJ11 / RJ45 type. The ADSL connection is presented on the middle two pins - i.e. pins 3&4 (RJ11) or pins 4&5 (RJ45). The other pins are not connected. Pin numbering is from the left, looking into the socket with the contacts uppermost. Polarity is unimportant.

5. ADSL electrical interface

The ADSL interface is compliant with ITU-T G.992.1 Annex A[1] and ITU-T G.994.1[4] with the following options / exceptions:

- ATM mode only (G.992.1 § 5.1.2, 6.2 & 7.2)
- Non-overlapped spectrum only
- Network timing reference not supported
- Framing mode 0 not supported

Optionally the interface may support ITU-T G.992.5 Annex A[3] (ADSL2plus), but in this case there will be an option, through the negotiation process of ITU-T G.994.1[4], to revert to an ITU-T G.992.1 Annex A[1] compliant interface at reduced performance (compared with what might have been possible had a connection been established with the ADSL2plus protocol).

In 2010 BT Wholesale launched a service based on ITU-T G.992.5 Annex M (ADSL2plus Annex M). This will also allow reversion to ITU-T G.992.5 Annex A (ADSL2plus) or ITU-T G992.1 Annex A (ADSL)

Exceptionally the interface may support ITU-T G992.5 Annex A[3] (ADSL2plus) ONLY, with no option to fallback to ITU-T G992.1 Annex A[1] but in this case the customer will made aware of the service restriction in advance.

The availability of ITU-T G992.5 Annex A (ADSL2plus) and Annex M is restricted to BT's 21CN network. Further information on which options are available for each service can be obtained by reading the SIN for the specific DSL service.

Where the interface supports ITU-T G.992.5 (ADSL2plus) it may also offer support for ADSL2/2plus low power mode (discussed within Sections 6.8, 7.12, 9.5, 10.3 & Table 8-4 of ITU-T Recommendation G.992.3 [2]) if supported by the MSAN line card variant , Customer Premise Equipment (CPE) and the applied DSL line profile. Further information on which options are available for each service can be obtained by reading the applicable SIN for the specific DSL service [9].

5.1 ADSL data rate

The data rate at which the ADSL line operates is configured by the BT network and will depend upon the requirements of the subscribed service.

5.2 ATM VPI / VCI

The number and VPI / VCI of the ATM virtual circuits transported by the ADSL line will depend upon the subscribed service and will be defined in related SINs.

6. ADSL modem device recommendations

6.1 General

In order to ensure correct operation with the BT network, ADSL modem devices intended for connection to BT ADSL lines should:

- Comply with ITU-T G992.1 Annex A[1] and ITU-T G.994.1[4]
- Be configured for ATM transport (ITU-T G.992.1 § 5.2.2, 6.2 & 8.2)
- Comply with the transport capacity requirements of ITU-T G.992.1 § 6.2
- Comply with the performance requirements of ITU-T G.992.1 Annex G region B (Europe), table G-1.

6.2 Operations and Maintenance Functionality

***Note**. Support within the End User CPE for the OAM cells described in this section will allow BT to diagnose faults at the ATM layer. Failure to support this I.610 functionality may lead to extra field force activity for which the Customer may be charged.*

ADSL CPE should be able to loop back all downstream traffic received on VPI0 VCI21 to the same VPI/VCI in the upstream direction (subject to a maximum data rate of 5kbit/s). This is so that a BT test system can perform a simple connectivity / performance test using ITU-T O.191[6] test cells.

In order for BT to perform ATM layer diagnostics all End User CPE should support the following aspects of ITU-T Recommendation I.610, 'B-ISDN operation and maintenance principles and functions' (02/99)[7].

6.2.1 VP Continuity Check (CC) (ITU-T I.610 Sect. 9.2.1.1.2)

Procedures for activation (and associated deactivation) of CC cells are described in I.610 Sect 9.2.3

ATM layer OAM cell formats can be found in I.610 Sect.10. Details of the specific fields required to identify a continuity check cell can be found in I.610 Sect.10.2.2. Details of the specific fields required to identify activation/deactivation cells can be found in I.610 Sect. 10.4. State diagrams detailing the activation/deactivation procedures of CC cells are shown in ANNEX B 'SDLs for activation/deactivation using OAM cells'.

Both e-t-e_VP-CC and seg_VP_CC should be supported.

6.2.2 VP performance management functions (FPM and BR cells) (ITU-T I.610 Sect. 9.2.1.2)

ITU-T I.610 Table 1 gives the list of cell types that should be considered as a "user cell" for VP performance monitoring.

Procedures for activation (and associated deactivation) of FPM and BR cells are described in 9.2.3.

Specific fields for performance management cells are given in I.610 Sect. 10.3.

Details of the specific fields required to identify activation/deactivation cells can be found in I.610 Sect. 10.4. State diagrams detailing the activation/deactivation procedures of performance monitoring cells are shown in ANNEX B 'SDLs for activation/deactivation using OAM cells'.

APPENDIX II contains informative material related to the insertion process applicable to end-to-end or segment performance management cells.

Both e-t-e_VP-FPM and seg_VP_FPM should be supported.

Both e-t-e_VP-BR and seg_VP_BR should be supported.

6.2.3 F4 Flows (ITU-T I.610 Sect. 9.2.1.)

F4 OAM cells operate at the virtual path level. The flow mechanisms for F4 cells can be found in I.610 Sect. 7.2.1. F4 cells are distinguished by set values of the VCI field in the ATM header. These values can be found in Table 1/ ITU-T I.610 - "User cells" at F4 level. A general description of OAM functions for the VPC (F4 flow) can be found in ITU-T I.610 Sect. 9.2.1.

6.2.4 F5 Flows (ITU-T I.610 Sect. 9.2.2.)

F5 OAM cells operate at the virtual channel level. The flow mechanisms for F5 cells can be found in I.610 Sect. 7.2.2. F5 cells are distinguished by set values of the PTI field in the ATM header. These values can be found in Table 2/I.610 - "User cells" at F5 level. A general description of OAM functions for the VCC (F5 flow) can be found in ITU-T I.610 Sect. 9.2.2.

6.2.5 VC-AIS and VC-RDI defect indication (ITU-T I.610 Sect. 9.2.2.1.1)

ATM layer OAM cell formats can be found in ITU-T I.610 Sect. 10. Details of the specific fields required to identify AIS/RDI cells can be found in ITU-T I.610 Sect. 10.2.21.

Both e-t-e_VC-AIS and seg_VC_AIS should be supported.

Both e-t-e_VC-RDI and seg_VC_RDI should be supported.

6.2.6 VC Continuity Check (CC) (ITU-T I.610 Sect. 9.2.2.1.2)

Procedures for activation (and associated deactivation) of CC cells are described in ITU-T I.610 Sect 9.2.3.

ATM layer OAM cell formats can be found in ITU-T I.610 Sect. 10. Details of the specific fields required to identify a continuity check cell can be found in ITU-T I.610 Sect. 10.2.2. Details of the specific fields required to identify activation/deactivation cells can be found in ITU-T I.610 Sect. 10.4. State diagrams detailing the activation/deactivation procedures of CC cells are shown in ANNEX B 'SDLs for activation/deactivation using OAM cells'.

Both e-t-e_VC-CC and seg_VC_CC should be supported.

6.2.7 VC Loopback (LB) (ITU-T I.610 Sect. 9.2.2.1.3)

ATM layer OAM cell formats can be found in ITU-T I.610 Sect. 10. Details of the specific fields required to identify a loopback cell can be found in ITU-T I.610 Sect. 10.2.3.

Upon receipt of a Loopback cell the CPE shall follow the procedure laid down in ITU-T I.610 ANNEX C 'Procedures to be performed when receiving LB cells'.

Both e-t-e_VC-LB and seg_VC_LB should be supported.

6.2.8 VC performance management functions (FPM and BR cells) (ITU-T I.610 Sect. 9.2.2.2)

ITU-T I.610 Table 2 gives the list of cell types that should be considered as a "user cell" for VC performance monitoring.

Procedures for activation (and associated deactivation) of FPM and BR cells are described in 9.2.3.

Specific fields for performance management cells are given in ITU-T I.610 Sect. 10.3.

Details of the specific fields required to identify activation/deactivation cells can be found in ITU-T I.610 Sect. 10.4. State diagrams detailing the activation/deactivation procedures of performance monitoring cells are shown in ANNEX B 'SDLs for activation/deactivation using OAM cells'.

APPENDIX II contains informative material related to the insertion process applicable to end-to-end or segment performance management cells.

Both e-t-e_VC-FPM and seg_VC_FPM should be supported.

Both e-t-e_VC-BR and seg_VC_BR should be supported.

7. CPE ADSL filter device recommendations

In order to ensure correct operation with the BT ADSL and PSTN networks, CPE ADSL filter devices intended for connection to BT ADSL lines should meet one of the two alternative sets of recommendations:

Either:

a) a filter compliant with the requirements of ETSI specification TS 101-952[8] as set out in section 7.1.

or

b) a filter compliant with the requirements enumerated in section 7.2 of this document.

Note: Either filter specification is equally acceptable. The specification given in section 7.2 was published in previous issues of this SIN and was produced prior to the development and publication of the specification given in section 7.1.

7.1 Filters compliant with TS101-952

In this case the filter should be compliant with TS 101-952[8] with the following options selected:

i) Option B category of section 6.1 of TS 101-952[8].

ii) The option to support metering pulses as described in section 6.7 of TS 101-952[8] does ***not*** need to be implemented.

iii) The option to provide common mode rejection as described in section 6.14 of TS 101-952[8] does not need to be implemented, although it is known that this option can help to improve DSL service reliability in some cases.

iv) The applicable column of Normative Annex A.2 would be the column entitled “ADSL over POTS” or the column entitled “ADSL2+ over POTS deployed from the LE”, depending on the form of ADSL service being offered.

7.2 Filters based on ITU-T Recommendation G.992.1

It should be noted that if the CPE ADSL filter is to be used in a multiple filter topology then the filter should pass the recommendations of this section with up to three other CPE ADSL filters (each with their Telephony Port open circuit) connected in parallel with the CPE ADSL filter under test.

(a) The CPE ADSL filter function between Line Port and Telephony Port should meet the requirements as detailed in Table 2 when terminated in $Z_{complex(2)}$ impedances.

Ref. Clause	Requirement	Comment
E.1.1.2	**Matching impedance** for voice terminals.	$Z_{complex(2)}$ = 230nF // 1050Ω + 320Ω is applicable for the BT network.
E.1.2	**Return loss.** TELE port and LINE port return loss against $Z_{complex(n)}$ when the other port is terminated in $Z_{complex(2)}$	The impedance used should be $Z_{complaex(2)}$ - see E.1.1.2 above. This requirement applies when the ADSL port is either open circuit or terminated in ZHP remote end defined in Figure 8.
E.1.3	**Insertion loss.** TELE port to LINE port insertion loss shall be < 1 dB at 1 kHz for $Z_{complex(2).}$	The impedance used should be $Z_{complaex(2)}$ - see E.1.1.2 above.
E.1.4	**Insertion loss distortion.** Insertion loss distortion 200-4000 Hz < ±1 dB term = $Z_{complex(2)}$	The impedance used should be $Z_{complaex(2)}$ - see E.1.1.2 above.
E.1.5	**Isolation** Isolation resistance, branch-earth > 10 M Ω term = ∞ Ω; 100 V DC Isolation resistance, branch-branch > 1 M Ω term = ∞ Ω; 100 V DC DC resistance < 50 Ω term = 0 Ω.	
E.1.6	**Signal Power** Maximum peak signal power in 200-4000 Hz < 3 dBm ETS-300.001 § 4.4.2 on 600 Ω Loop current < 100 mA	
E.1.7	**Ringing** Ringing frequency 25-50 Hz Ringing AC < 100 V_{rms} Ringing DC (AC superimposed on DC) < 100 V	
E.1.8	**Unbalance about Earth (ETS 300 001, §4.2.1 and §4.2.2** LCL (test method Recommendation G.117, subclause 4.1.3) TCL (test method Recommendation G.117, subclause 4.1.3) 15-50 Hz > 40 dB terminated with 600 Ω 50-600 Hz > 46 dB terminated with 600 Ω 600-3400 Hz > 52 dB terminated with 600 Ω	
E.1.9	**Frequencies and levels for pulse metering (ETS 300 001 §1.7.8)** Frequency 12/16 kHz ±1% Insertion loss < 3 dB in 200 Ω Maximum level < 5 V_{rms} in 200 Ω	The BT network uses the 50Hz signal described in ETS-300.001, § 1.7.8. BT does not currently use the high frequency meter pulse signal. The support of the high or low frequency meter pulse signal is optional.

Table 2. Splitter requirements

Note to Table 2. In the case of a two port splitter (i.e. with line and Telephony Ports only) the ADSL Port is a parallel connection to the Line Port.

(b) The longitudinal balance when measured at the Line Port between 25 kHz and 1.104 MHz (2.208 MHz for ADSL2+) when the Telephony Port is terminated in a centre-grounded 100 Ohm load should be better than 40 dB.

(c) The longitudinal balance when measured at the Telephony Port between 25 kHz and 1.104 MHz (2.208 MHz for ADSL2+) when the Line Port is terminated in a centre-grounded 100 Ohm load should be better than 40 dB.

(d) The input impedance of the Line Port should be 100 Ohms with a minimum Return Loss of 16 dB from 200 kHz to 1 MHz with the ADSL Port terminated in 100 Ohms.

(e) The insertion loss when the attached telephone is off hook between 100 Ohm source and loads at Line and Telephony Ports should be greater than 29 dB at 32 kHz and greater than 55 dB from 200 kHz to 1.104MHz. (2.208 MHz for ADSL2+).

(f) The insertion loss when the attached telephone is on hook between 100 Ohm source and loads at Line and Telephony Ports should be greater than 29 dB at 32 kHz and greater than 55 dB from 350 kHz to 1.104MHz. (2.208 MHz for ADSL2+).

(g) The loss* when the attached telephone is on hook between a 100 Ohm source at the Line port and a load of 4k Ohm in parallel with a 1nF capacitor at the Telephony Port should be greater than 29 dB at 32 kHz and greater than 55 dB from 350 kHz to 1.104MHz. (2.208 MHz for ADSL2+).

> * In this case loss is defined as 20log(V1/V2) where V1 is the source EMF and V2 is the voltage appearing across the load at the telephony port.

(h) Common-mode insertion loss between 50 Ohm source and loads at Line and Telephony Ports should be greater than 30 dB between 26 kHz and 1.104 MHz. (2.208 MHz for ADSL2+).

(i) Voice band noise at the Telephony Port in the presence of ADSL line signals at the Line Port should be less than –70dBmp.

(j) In order to pass CLI signalling to the PSTN CPE, the filter should pass voice band signals (with a voltage gain of ± 3dB) when no line current is flowing, the Line Port is terminated in $Z_{complex(2)}$ and the Telephony Port is terminated with a 4kOhm resistor in parallel with a 1nF capacitor.

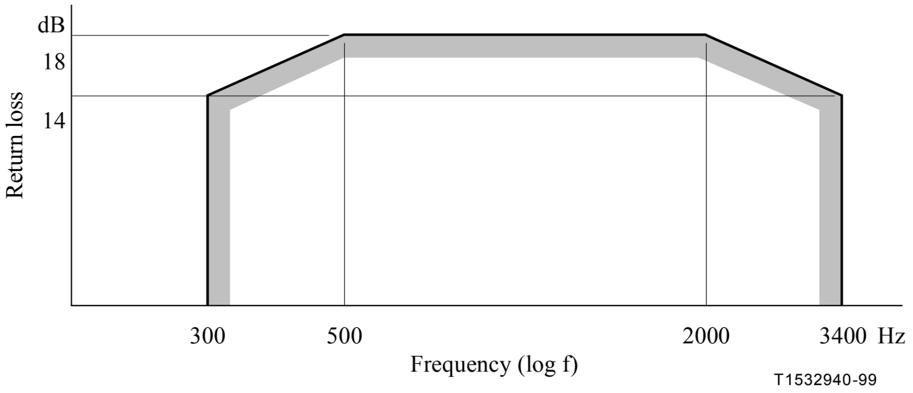

Figure 7. Remote splitter return loss recommendation

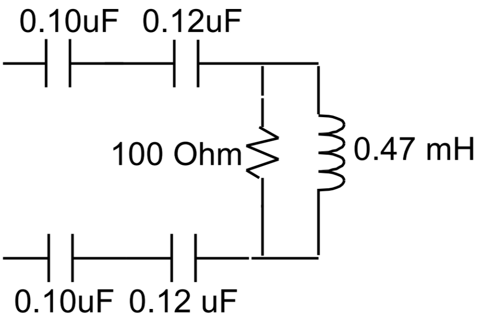

Figure 8. ZHP definition

7.3 Additional notes about CPE filters

Note that the standard BT PSTN CPE interface is a 3 wire circuit whereby the bell wire is AC-coupled from line B. This bell wire must either be filtered by the filter or left open circuit at the Line Port and recreated at the Telephony Port of the filter. This is may be achieved using a 1.8 µF capacitor between line B (pin 5) and the bell wire (pin 4) at the Telephony Port.

It should be noted that during normal operation of BT PSTN services switching may occur between line states such as line feed, reversed line feed, ringing and dialling (loop disconnect or tone). These changes of state may be associated with large transient voltage excursions. The performance of data circuits operating from the ADSL Port under these conditions is a function of the data modem internal performance and other factors and may be a cause for specifications outside the scope of this document.

The wires of the line may be disconnected, shorted together, taken to earth or connected to standard network conditions (Voltages up to -95 V, PSTN conditions, ringing etc) at any point in the system. No maintenance intervention should be required after such an event to restore normal operation.

8. Out of band signals applied to the PSTN CPE

It should be noted that due to the nature of ADSL technology where PSTN and data signals are separated using analogue filters, there is inevitably some leakage of the ADSL line signal through the splitter filter. This will result in small out of band transverse signals being applied to the PSTN CPE. Under normal circumstances in the case of a BT ADSL Linebox adapter installation, the power spectral density of these signals due to ADSL should be no greater than -54dBm/Hz in the 26 - 138kHz band and -76dBm/Hz in the 138kHz – 1.104MHz band (138 kHz - 2.204 MHz in the case of ADSL2+). Similar leakage signals can be expected through CPE ADSL filters which comply with the recommendations in section 7. Note that Standards have allowed for out of band line signals considerably larger than those caused by ADSL filter leakage. For the BT network this allowance is declared in SIN 351[5].

9. Glossary of terms

Acronym	Expansions
30K	30K Ohm Loop Signalling
AC	Alternating Current

Acronym	**Expansions**
ADSL	Asymmetric Digital Subscriber Line
ATM	Asynchronous Transfer Mode
BT	British Telecommunications plc
CLI	Calling Line Identity
CPE	Customers' Premises Equipment
dB	decibel
dBm	Decibels in milliwatts
DC	Direct Current
EMF	Electromotive Force (Voltage)
ETS	European Telecommunications Standard [ETSI]
F5	Flow 5 [ATM]
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunications Union Telecommunication
kHz	Kilohertz - 1000 Hz
MHz	Megahertz- 1,000,000 Hz
NTP	Network Terminating Point
OAM	Operations And Maintenance
PBX	Private Branch Exchange
PSTN	Public Switched Telephone Network
RJ11	Registered Jack 11
RJ45	Registered Jack 45
SPM	Subscriber Private Meter
VCI	Virtual Channel Identifier [ATM]
VPI	Virtual Path Identifier [ATM]
ZHP	Impedance high pass filter

10. References

[1]	ITU-T G.992.1	Asymmetrical Digital Subscriber Line (ADSL) transceivers	
[2]	ITU-T G.992.3	Asymmetrical Digital Subscriber Line (ADSL) transceivers 2 (ADSL2)	
[3]	ITU-T G.992.5	Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2plus)	
[4]	ITU-T G.994.1	Handshake Procedures for Digital Subscriber Line Transceivers	
[5]	SIN 351	BT Public Switched Telephone Network (PSTN): Technical Characteristics Of The Single Analogue Line Interface	
[6]	ITU-T O.191	Equipment to measure the cell transfer performance of ATM connections	
[7]	ITU-T I.610	B-ISDN operation and maintenance principles and functions	02/99
[8]	ETSI TS 101 952-1-1 V1.2.1	Access network xDSL transmission filters; Part 1: ADSL splitters for European deployment; Sub-part 1: Generic specification of the low pass part of DSL over POTS splitters	12/04
[9]	SIN 472	BT Wholesale Broadband Connect (WBC) Products, Service Description	

11. History

Date	Issue	Comments
July 2000	Issue 1	First issue
April 2001	Issue 1.1	Editorial changes. Informative text, and note, on BT test systems added to ADSL modem device recommendations section.
August 2001	Issue 2	Document restructured. Addition of CPE ADSL filter specification and topology, out of band signals leakage to the PSTN CPE and reference to ADSL modem test lab.
October 2001	Issue 2.1	Editorial changes to clarify topology options and source of CPE ADSL filter specification requirements
July 2002	Issue 2.2	Removed unnecessary common mode loss requirement between ADSL and line ports. Corrected on hook test load conditions. Altered on hook impedance definition to include a capacitive element.
August 2003	Issue 2.3	Section 6.2 (OAM Functionality) included to provide a recommendation for the end-user CPE to support F5 loopback. Figure 6 amended to show missing filter between end user CPE and extension socket. Clause on CPE approval requirements removed.
November 2003	Issue 2.4	Section 2 – changes to circumstances of incompatibility on Redcare.
August 2004	Issue 2.5	Section 1 – Changes made to include a new repair process.
February 2006	Issue 2.6	Updated to cover 21CN versions, possibility of ADSL2+, and CPE filters to TS101952, and reformatted for clarity.
January 2008	Issue 2.7	Updated to remove explicit support for ADSL2
March 2010	Issue 2.8	Updated to add support for Annex M. Minor change to section 5 and to referencing ITU-T Recommendations.
March 2011	Issue 2.9	Amendment to Section 5 to reflect status of the product referred to.
October 2011	Issue 2.10	Minor corrections & addition of low power mode support
July 2015	Issue 2.11	Removed references to BT Datastream Change SINet site references from http://www.sinet.bt.com to http://www.btplc.com/sinet/
October 2019	Issue 2.12	Removed section 9 – ADSL CPE test lab

July 2020	Issue 2.13	Change SINet site references from http://www.btplc.com/sinet/ to https://www.bt.com/about/sinet

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